CLAIMS

1. A PET scanner comprising:

a scintillator block;

a plurality of photodetectors;

an optical element disposed between the scintillator block and the plurality of photodetectors, the optical element having:

a first layer that includes a central region having an outer wall and a peripheral region having an inner wall, the inner and outer wall being separated by a first gap; and

a second layer in optical communication with the first layer, the second layer including at least a first region and a second region, the first region having a first interior wall and the second region having a second interior wall opposite the first interior wall, the first and second interior walls being separated by a second gap.

2. The PET scanner of claim **1**, wherein the first layer comprises a perimeter wall, and the peripheral region is adjacent to at least a portion of the perimeter wall.

3. The PET scanner of claim **1**, wherein the peripheral region is adjacent to the entire perimeter wall.

4. The PET scanner of claim **1**, further comprising one or more additional peripheral regions, the one or more additional peripheral regions being adjacent to a portion of the perimeter wall that is not adjacent to the peripheral region.

5. The PET scanner of claim **4**, wherein an additional peripheral region is separated from the peripheral region by a gap.

6. The PET scanner of claim **5**, wherein the gap extends to the perimeter wall.

7. The PET scanner of claim **1**, wherein the inner wall and the outer wall have different optical characteristics.

8. The PET scanner of claim **7**, wherein one of the inner wall and the outer wall is polished and the other is unpolished.

9. The PET scanner of claim **7**, wherein one of the inner wall and the outer wall is opaque and the other is not opaque.

10. The PET scanner of claim **7**, wherein one of the inner wall and the outer wall is black and the other is not black.

11. The PET scanner of claim **7**, wherein one of the inner wall and the outer wall is transparent and the other is not transparent.

12. The PET scanner of claim **7**, wherein one of the inner wall and the outer wall is translucent and the other is not translucent.

13. The PET scanner of claim **7**, wherein one of the inner wall and the outer wall is absorbtive and the other is not absorbtive.

14. The PET scanner of claim **7**, wherein one of the inner wall and the outer wall is configured to cause a specular reflection and the other is cause a reflection other than a specular reflection.

15. The PET scanner of claim **14**, wherein the one of the inner wall and the outer wall that is configured to cause a specular reflection comprises a metal coating.

16. The PET scanner of claim **14**, wherein the one of the inner wall and the outer wall that is configured to cause a specular reflection comprises a reflective coating.

17. The PET scanner of claim **14**, wherein the one of the inner wall and the outer wall that is configured to cause a specular reflection has an index of refraction selected to cause total internal reflection of light incident thereon.

18. The PET scanner of claim **7**, wherein one of the inner wall and the outer wall is configured to cause a diffuse reflection and the other is cause a reflection other than a diffuse reflection.

19. The PET scanner of claim **18**, wherein the one of the inner wall and the outer wall that is configured to cause a diffuse reflection comprises a plastic coating.

20. The PET scanner of claim **18**, wherein the one of the inner wall and the outer wall that is configured to cause a diffuse reflection comprises a coating of paint.

21. The PET scanner of claim **18**, wherein the one of the inner wall and the outer wall that is configured to cause a diffuse reflection has a roughened surface.

22. The PET scanner of claim **7**, wherein a surface of the inner wall is polished.

23. The PET scanner of claim **7**, wherein an inner surface of the outer wall is roughened.

24. The PET scanner of claim **1**, wherein the optical element further comprises a third layer disposed adjacent to the scintillator block.

25. The PET scanner of claim **1**, wherein the first gap has an optical property that is different from a corresponding optical property of the central region and the peripheral region.

26. The PET scanner of claim **25**, wherein the first gap comprises an air gap.

27. The PET scanner of claim **1**, wherein one of the first interior wall and the second interior wall is polished and the other is unpolished.

28. The PET scanner of claim **1**, wherein one of the first interior wall and the second interior wall is opaque and the other is not opaque.

29. The PET scanner of claim **1**, wherein one of the first interior wall and the second interior wall is black and the other is not black.

30. The PET scanner of claim **1**, wherein the first interior wall and the second interior wall are specularly reflecting walls.

31. The PET scanner of claim **1**, wherein the second gap defines a grid of regions.

32. The PET scanner of claim **31**, wherein the second gap extends across the second layer.

33. The PET scanner of claim **31**, wherein the second gap extends part way across the second layer.

34. The PET scanner of claim **1**, wherein the opposed first and second interior walls are parallel.

35. The PET scanner of claim **1**, wherein the opposed first and second interior walls are not parallel.

36. The PET scanner of claim **31**, wherein each region in the grid of regions is positioned to correspond to a photodetector from the plurality of photodetectors.

37. The PET scanner of claim **1**, wherein the second gap is a cruciform gap.

38. The PET scanner of claim **37**, wherein the cruciform gap comprises intersecting first and second arms, at least one of the first and second arms extending across the second layer.

39. The PET scanner of claim **37**, wherein the cruciform gap comprises intersecting first and second arms, the first and second arms extending part way across the second layer.

40. The PET scanner of claim **1**, further comprising a mask disposed to prevent scintillation photons emerging from selected portions of the optical element from reaching the photodetectors.

41. The PET scanner of claim **40**, wherein the mask comprises regions forming apertures at locations opposite the photodetectors.

42. The PET scanner of claim **40**, wherein the mask is disposed between the optical element and the photodetectors.

43. The PET scanner of claim **40**, wherein the mask is absorbtive.

44. The PET scanner of claim **40**, wherein the mask is reflective.

45. The PET scanner of claim **44**, wherein the mask is specularly reflective.

46. The PET scanner of claim **44**, wherein the mask is diffusely reflective.

47. An optical element for directing light from a scintillator block to a plurality of photodetectors, the optical element comprising:

a first layer in optical communication with the scintillator block, the first layer having a central region having an outer wall and a peripheral region having an inner wall, the inner and outer wall being separated by a first gap; and

a second layer in optical communication with the plurality of photodetectors and with the first layer, the second layerincluding at least a first region and a second region, the first region having a first interior wall and the second region having a second interior wall opposite the first interior wall, the first and second interior walls being separated by a second gap.

48. The optical element of claim **47**, wherein the inner wall and the outer wall are configured such that a photon incident on the inner wall from the peripheral region encounters a first reflection coefficient that is greater than a second reflection coefficient encountered by a photon incident on the outer wall from thc central region.

49. The optical element of claim **47**, wherein an inner surface of the inner wall of the peripheral region has a greater reflection coefficient than an inner surface of the outer wall of the central region.

50. The optical element of claim **49**, wherein the inner surface of the inner wall is polished.

51. The optical element of claim **49**, wherein the inner surface of the outer wall is roughened.

52. The optical element of claim **47**, wherein the optical element further comprises a third layer disposed facing the scintillator block.

53. The optical element of claim **47**, wherein the first gap comprises an air gap.

54. The optical element of claim **47**, wherein the first interior wall and the second interior wall are specularly reflecting walls.

55. The optical element of claim **47**, wherein the second gap defines a grid of regions.

56. The optical element of claim **55**, wherein each region in the grid of regions is positioned to correspond to a photodetector from the plurality of photodetectors.

57. The optical element of claim **47**, wherein the second gap is a cruciform gap.

58. A PET scanner comprising:

a scintillator block for generating a spatial light distribution of scintillation photons in response to illumination by a gamma ray photon;

means for an outer and inner the spatial light distribution of scintillation photons to generate a modified spatial light distribution; and

a plurality of photodetectors for receiving the modified spatial light distribution from the outer and inner means.

59. An optical element for directing light from a scintillator block to a plurality of photodetectors, the optical element comprising:

a structured outer layer in optical communication with the scintillator block; and

a structured inner layer in optical communication with the plurality of photodetectors.

60. A PET scanner comprising:

a scintillator block;

a plurality of photodetectors;

an optical element as recited in claim **59**, the optical element being disposed between the scintillator block and the plurality of photodetectors.